OFFSITE DRAINAGE REPORT

Ramona Assisted Living
1236 "D" Street
Ramona, CA 92065
JOB # 7163

Prepared for

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Introduction

Introduction. This report is to evaluate the offsite drainage conditions for a proposed assisted living care facility located at 1236 “D” Street, Ramona, CA. The parcel is approximately 0.37 acres, in the unincorporated area of San Diego County. Please see the drainage map on the next page, depicting the offsite drainage area and the site. The parcel use is currently a residential home, with a mild slope draining to the frontage on “D” Street, a paved road.

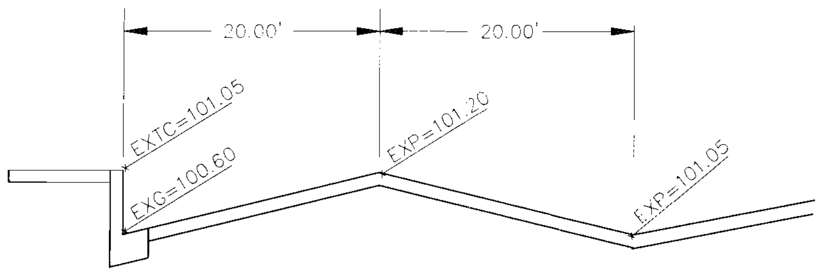
There are existing homes adjoining all sides of the site, with a density of 3-4 dwelling units per acre. Main St is one block north of the site, with neighborhood commercial development. A site visit was done on 8/6/08 to determine specific drainage conditions, land use, and to perform topographic survey at critical locations.

The design storm used for the hydrologic analysis is a summer storm, with higher rainfall intensity over small areas. For this site, the hydrology of interest is primarily storms originating from the west. As the storms move east, approaching the coastal mountains, the precipitation transitions into orographic uplift conditions, resulting in heavier rainfall on the westward slopes of the coastal mountains. This storm pattern is typical for the inland areas of San Diego County.

Drainage Impact Analysis Methodology. To evaluate the impact of the proposed development on existing drainage patterns, two locations were examined for hydrology and hydraulics. The first location is “D” Street, just downstream (west of) from the site, which was evaluated for street capacity using Manning’s equation. Please see sections ‘B’ and ‘C’ labeled on the drainage map. The second location is the ultimate discharge point, an existing 16 ft curb opening on the west side of the intersection of 14th Street and “D” Street. The curb opening was evaluated for inlet capacity, per San Diego County design procedures.

Hydrology. The peak flows for the 100 year event were calculated using the Rational method, per San Diego County Flood Control Hydrology Manual procedures. Please see the offsite drainage map and appendix for detailed calculations and referenced figures from the Hydrology Manual. The offsite contributing drainage area is 19.5 acres. Existing land use is approximately

Area: 19.52 acres

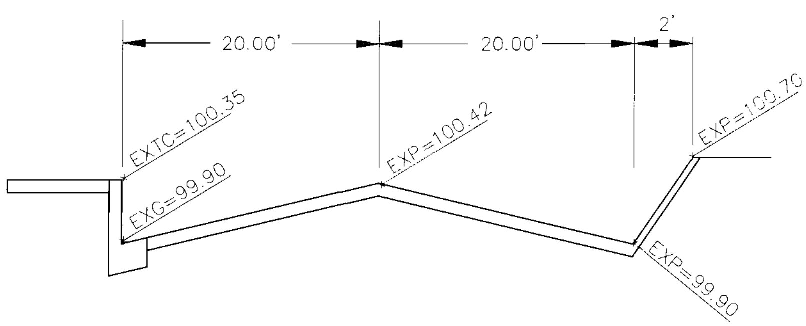


"D" STREET SECTION "C"

APPROX STA 3+15 E, LOOKING EAST

NO SCALE

LONGITUDINAL SLOPE = 0.47%



"D" STREET SECTION "B"

APPROX STA 1+50 E, LOOKING EAST

INTERSECTION OF "D" & 14TH ST, EASTERLY CURB RETURN

NO SCALE

50% neighborhood commercial and 50% residential. The proposed development is 0.37 acres, or 1.9% of the overall offsite contributing drainage area. Calculated flows at *Concentration Point A* (Intersection of 14th & "D" Street) are as follows:

Pre-Development Q100 = 45.98 cfs   Post Development Q100 = 46.40 cfs

This represents a 0.42cfs increase (0.91%) for developed conditions, a statistically insignificant increase given the limits of the Rational Method. The increase is due to the change in the weighted run-off coefficient for pre and post development conditions:

C_w=0.655 (Pre-development) C_w=0.661 (Post-development)

Hydraulics – Street Capacity. A spreadsheet program, which uses Manning's Equation, was used to calculate capacity for the half-street, from Centerline to Face-of-Curb for "D" Street at sections B and C. The spreadsheet program allows the user to specify roughness coefficient, street width, pavement cross-slope, and curb height (depth of water at curb). The output table lists street capacity and velocity as it changes with respect to longitudinal street slope. For water depth at top of curb (0.5ft), the half-street capacity is 13.15 cfs, or a total street capacity between curbs of 26.30 cfs, which is below Q_{100}=45.98 cfs (pre-development).

The spreadsheet program was also used to model the depth of water at curb for the 100 year event, neglecting any capacity outside of the curb. The post development conditions will raise the 100 year water surface by approximately 0.002 ft, a statistically insignificant amount. The specific results:

	½ Street Capacity	Curb to Curb Capacity	Depth at curb
Pre-development	23.09 cfs	46.18 cfs	0.592
Post-development	23.35 cfs	46.70 cfs	0.594

Hydraulics – Curb Opening Capacity. The 16 foot curb inlet capacity was reviewed per Fig 2-5, San Diego County Drainage Design Manual (2005) for sump conditions, assuming a depth of 12" at curb for the 100 year event. The capacity is approximately 50 cfs for orifice conditions, which exceeds the post development flow of 46.40 cfs.

Conclusion. The proposed development will have very minor impact on the downstream drainage conditions; the increase in the 100 year water surface elevation will be statistically insignificant. The 100 year-6 hour rainfall event, under current conditions, will over top the curb on "D" Street by approximately 0.092 feet. The post-development conditions will raise the water surface by 0.002 feet, which is statistically insignificant.

The existing 16 ft curb inlet capacity at 14th Street & "D" exceeds the pre and post development condition for the 100 year event.

APPENDIX

RAMONA ASSISTED LIVING CTR

OFFSITE HYDROLOGY - EXISTING

PT. A 16' CURB OPENING 14TH & D STREET

AREA / SLOPE

CONTRIBUTING AREA = 19.5 AC

$L = 1944$ LF HIGH POINT = 1429 LOW = 1421

$S = 8/1944 = 0.412\%$

RUNOFF COEFFICIENT

LAND USE: 50% NEIGHBORHOOD COMM

$C = 0.79$ SOIL "D" FIG 3-6

50% MEDIUM DENSITY RESIDENTIAL (4.3)

$C = 0.52$ SOIL "D" FIG 3-6

$C_W = (0.79 + 0.52)/2$

$= 0.655$

TIME OF CONCENTRATION (T_c)

$T_c = T_i + T_t$

$= 8.1 + 13.5$ MIN

$= 21.6$ MIN

$T_i = 8.1$ MIN FOR 2%, MDR 4.3

TABLE 3-2

T_t:

$1/2 Q = 19$ cfs $S = 0.4\%$

$V = 2.4$ fps PER FIG 3-6

$1944/2.4 = 810$ SEC $= 13.5$ MIN

INTENSITY

100 YR 6 HR $= P_6 = 3.3$ INCH (SD HYDRO MANUAL)

$I_{100} = 3.6$ IN/HR (PER FIG 3.1)

RAMONA ASSISTED LIVING

PT A (CONTINUED)

$Q_{100} = CIA$

$= 0.655\ (3.6\ IN/HR)\ (19.5\ AC)$

$= \underline{\underline{45.98\ cfs}}$ (EXISTING)

OFFSITE HYDROLOGY - POST DEVELOPMENT

PT. A

CONTRIBUTING AREA = 19.5 AC

9.75 AC = COMM C = 0.79 (EXISTING)

SITE AREA $= \frac{16,000}{43560} = 0.37$ AC C = 0.82 (PROPOSED)

9.38 AC = RES C = 0.52 (EXISTING)

$$C_W = \frac{9.75}{19.5}(0.79) + \frac{0.37}{19.5}(0.82) + \frac{9.38}{19.5}(0.52)$$

$= .661$

$\underline{\underline{Q_{100\,(POST)}}} = 0.661\ (3.6\ IN/HR)\ (19.5\ AC)$

$= \underline{\underline{46.40\ cfs}}$ (POST - DEVELOPMENT)

INCREASE = 46.40 - 45.98 = 0.42 cfs OR 0.91%

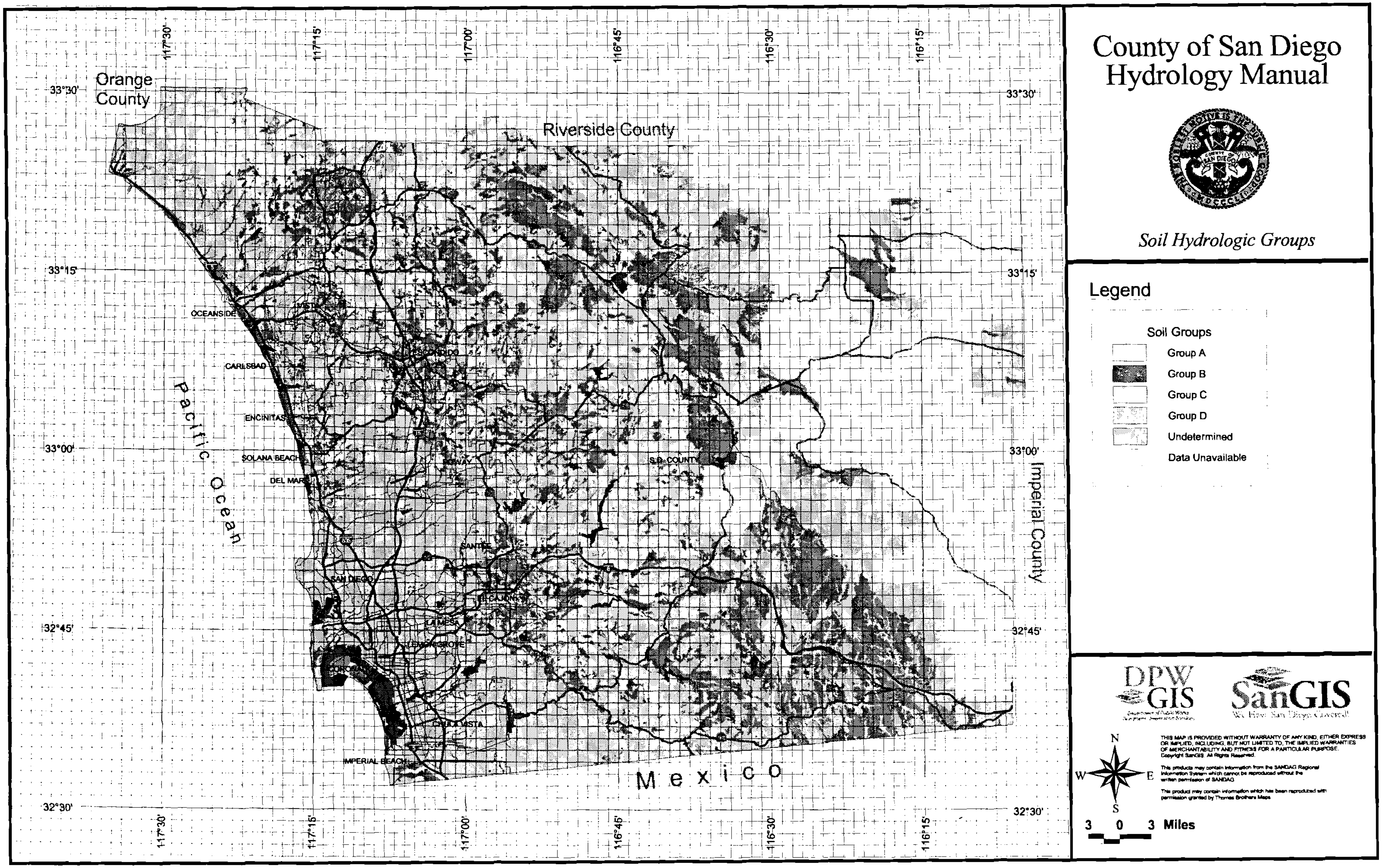

County of San Diego
Hydrology Manual
Soil Hydrologic Groups
Legend
Soil Groups
Group A
Group B
Group C
Group D
Undetermined
Data Unavailable
Orange County
Riverside County
Imperial County
Pacific Ocean
Mexico
OCEANSIDE
CARLSBAD
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CHULA VISTA
IMPERIAL BEACH
33°30'
33°15'
33°00'
32°45'
32°30'
117°30'
117°15'
117°00'
116°45'
116°30'
116°15'
N
S
E
W
3 0 3 Miles
DPW GIS
SanGIS
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Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"					
			Soil Type				
NRCS Elements	County Elements	% IMPER.	A	B	C	D	
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35	
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41	
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46	
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49	
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52	RES EXISTING
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57	
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60	
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63	
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71	
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79	
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79	COMM EXISTING
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82	SITE PROPOSED
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85	
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85	
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87	

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

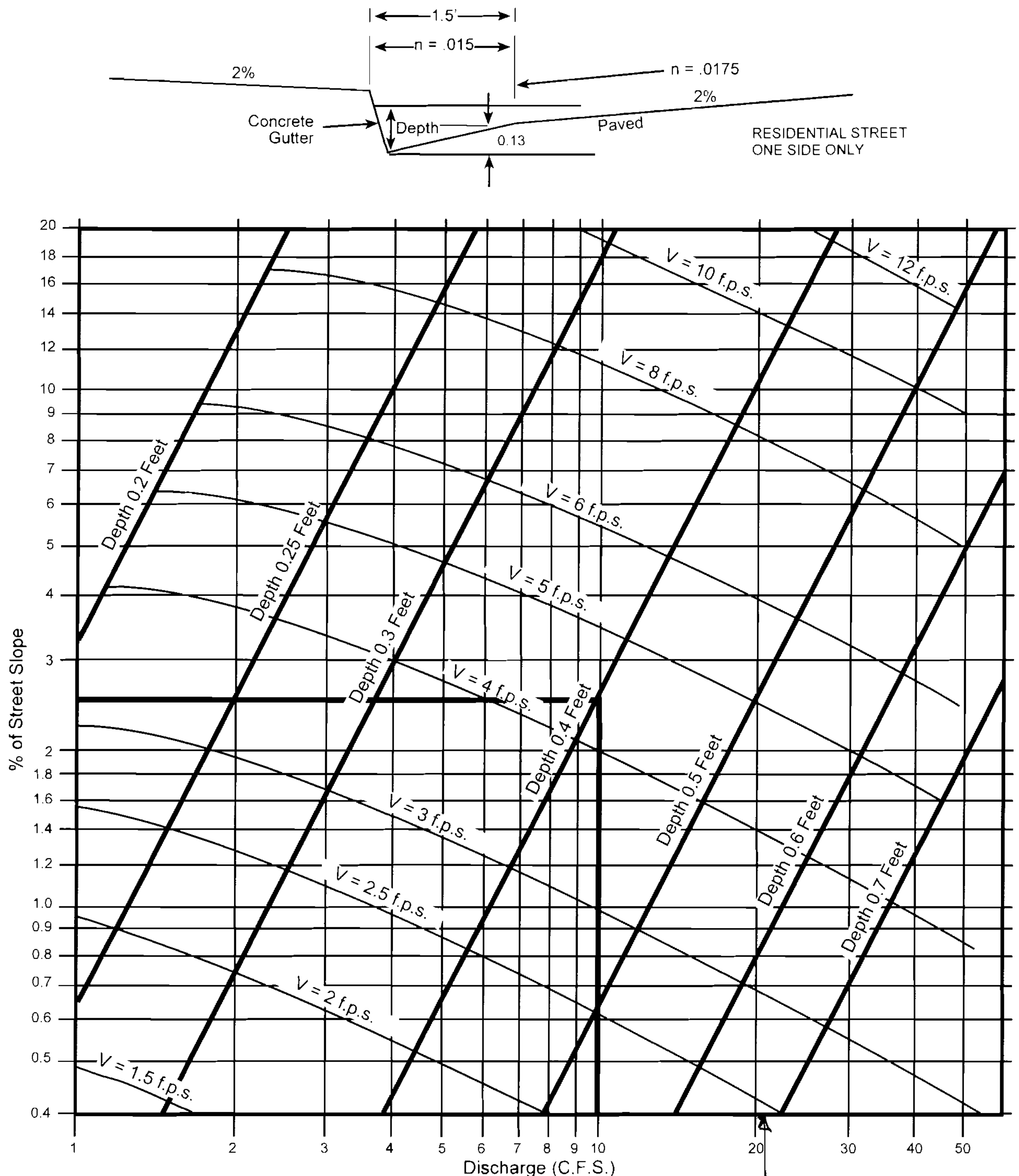
Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

$T_i = 8.1$ min

*See Table 3-1 for more detailed description



EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

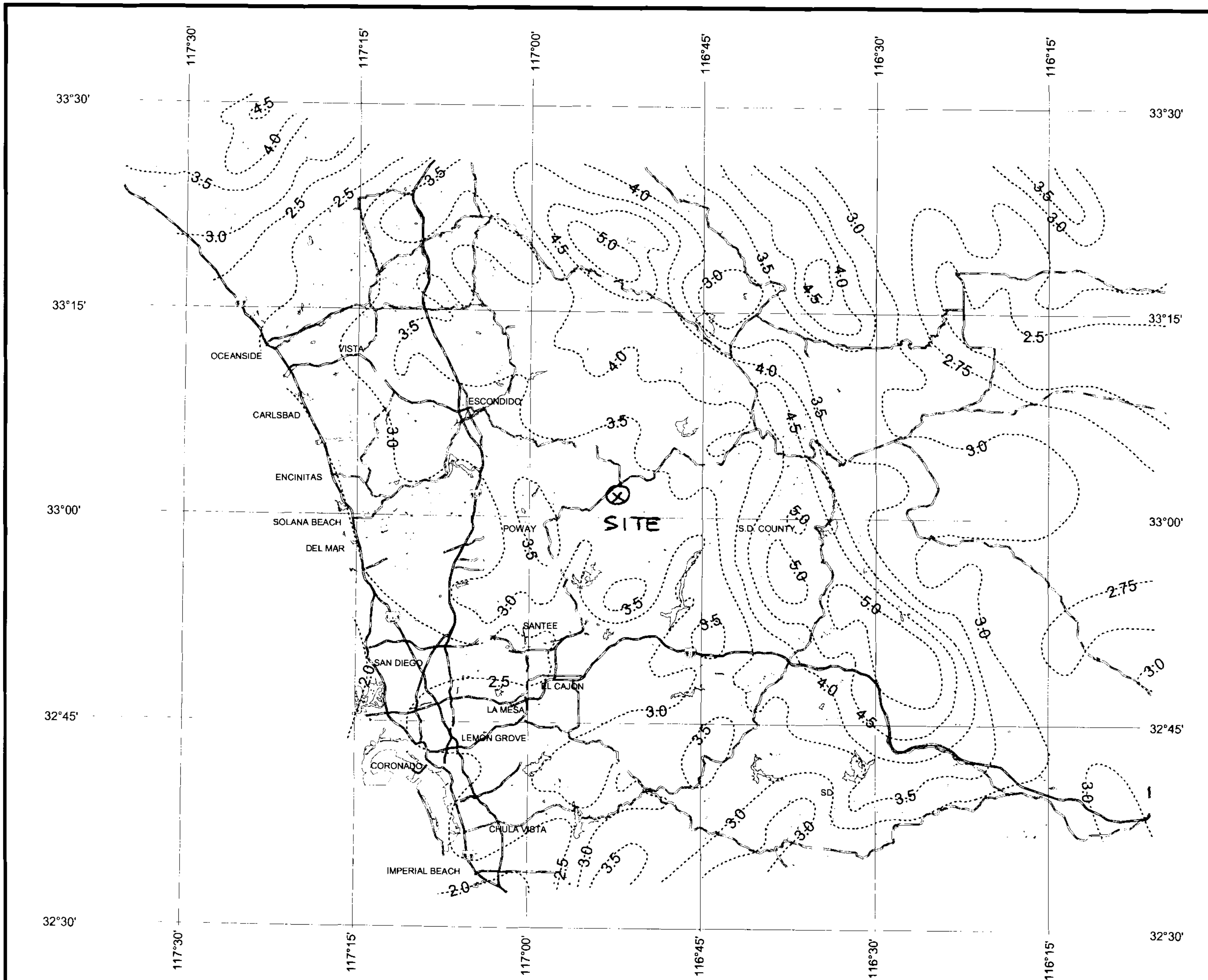
V = 2.4 fps

OFFSITE
Q AVG (100)

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE **3-6**

Gutter and Roadway Discharge - Velocity Chart



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

.... Isopluvial (inches)

$P_6 = 3.3$ inch

GIS

GIS

N
W E
S

3 0 3 Miles

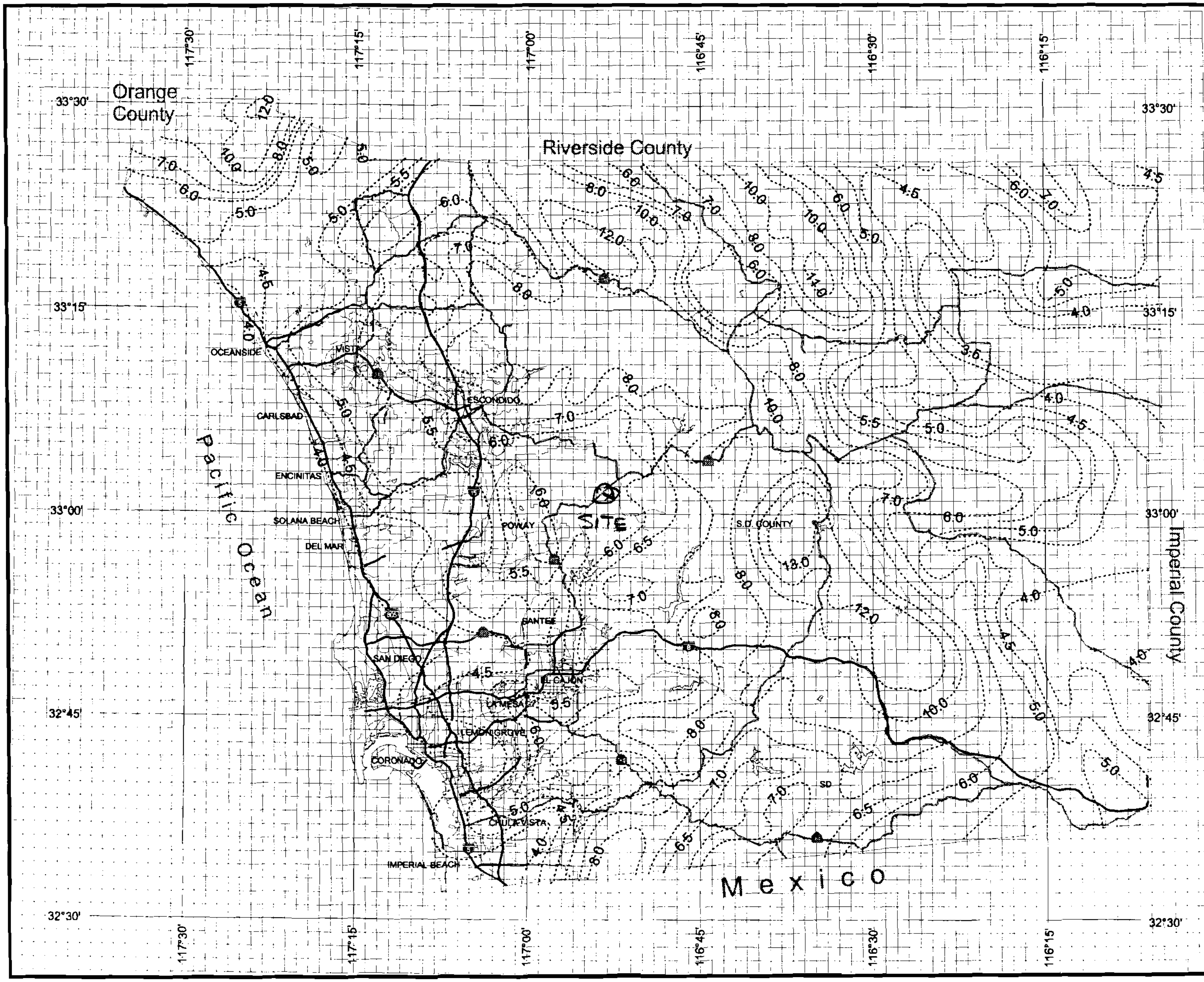
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

------- Isopluvial (inches)

$P_{24} = 5.8$

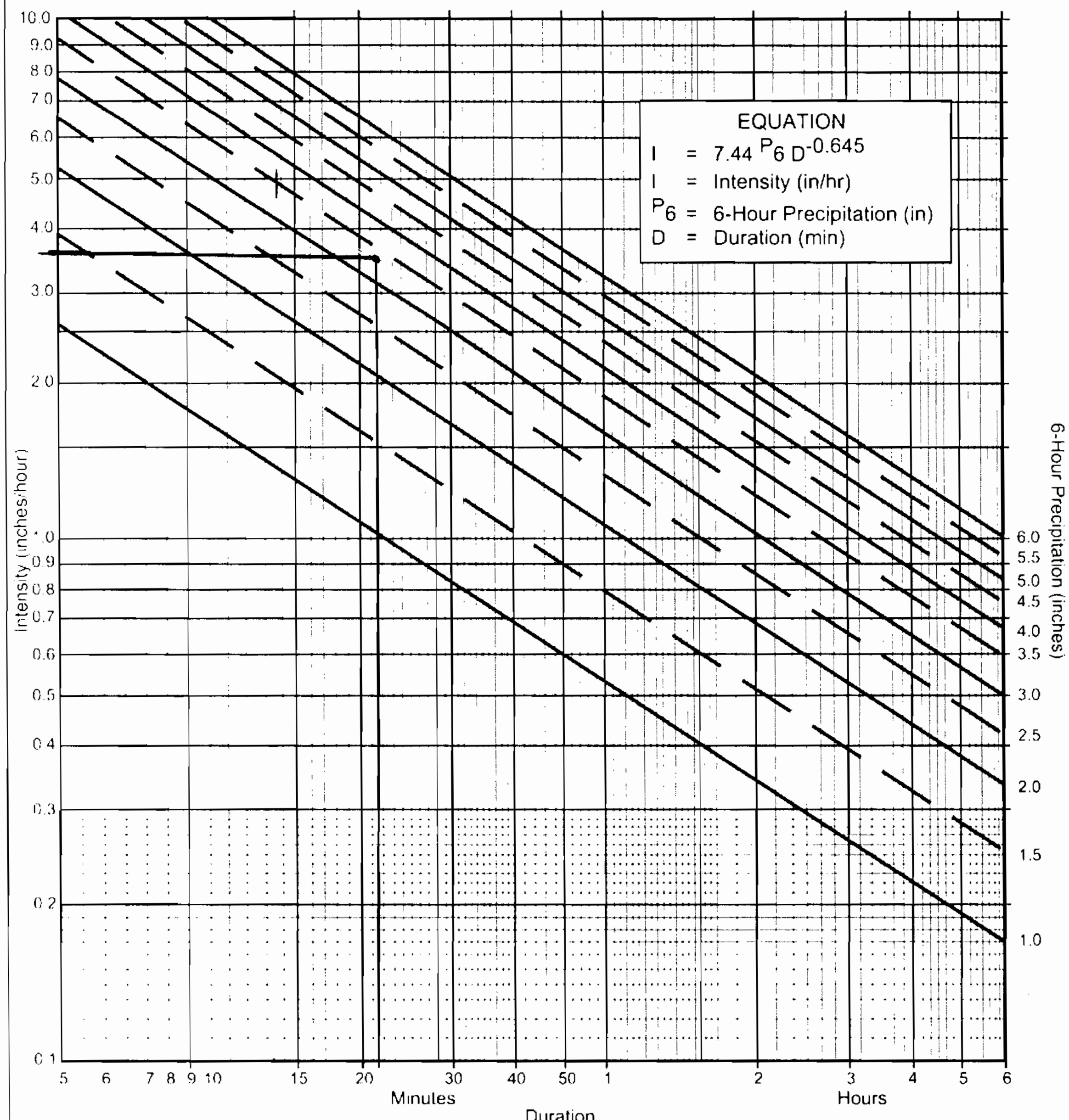


DPW GIS

SanGIS
We Have San Diego Covered!

N S W E

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.3 in., P_{24} = 5.8, $\frac{P_6}{P_{24}}$ = 57 %(2)

(c) Adjusted P_6(2) = 3.3 in.

(d) t_x = 21.6 min.

(e) I = 3.6 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

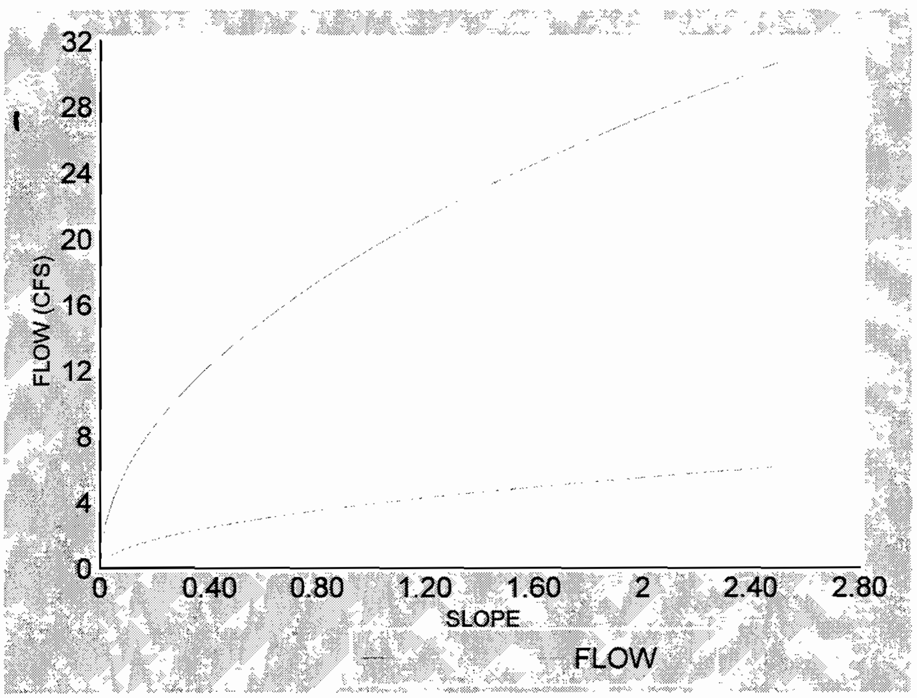
Intensity-Duration Design Chart - Template

FIGURE 3-1

HALF STREET FLOW CAPACITY CHART
6" VERTICAL CURB 20FT FC / CL

MANNING ROUGHNESS = 0.015
CURB HEIGHT = 0.5 FEET
CROSSSLOPE = 2% 20
CURB WIDTH = 0.5 FEET
STREET WIDTH TO B/C = 20 FEET
FLOW AREA, A = 5.0000 SQ FEET
WETTED PERIMETER, Pw = 20.50 FEET
HYDRAULIC RADIUS, R = 0.244 FEET

THIS SPREADSHEET IS ONLY ACCURATE IF THE CURB IS EQUAL
TO OR LOWER THAN THE CENTER LINE OF THE ROADWAY

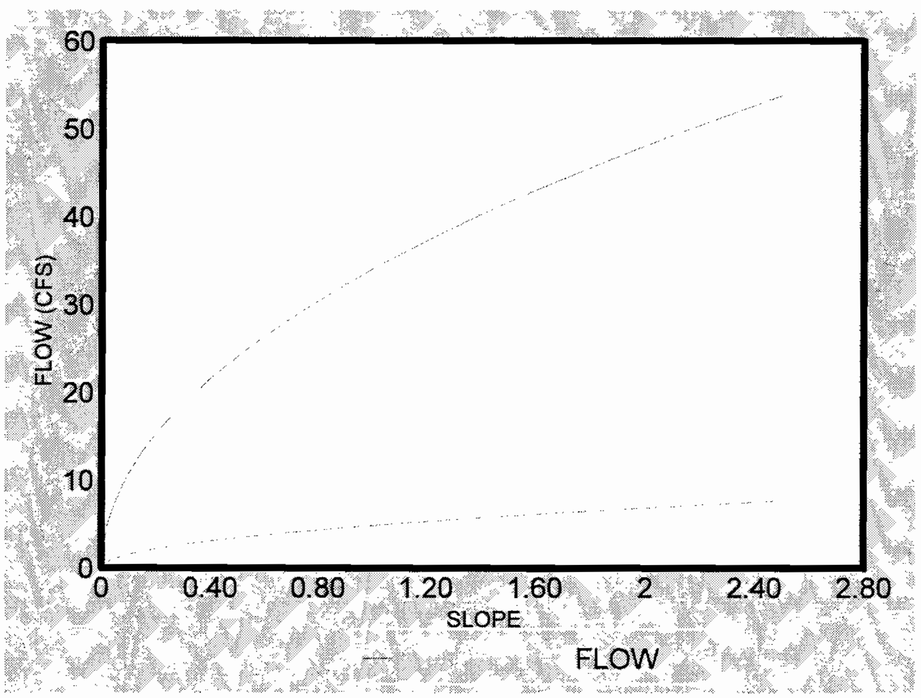


PERCENT SLOPE TABLE:	VELOCITY	FLOW
0.00	0.00	0.00
0.02	0.55	2.74
0.05	0.87	4.34
0.08	1.10	5.48
0.10	1.23	6.13
0.15	1.50	7.51
0.18	1.65	8.23
0.20	1.73	8.67
0.21	1.78	8.88
0.22	1.82	9.09
0.23	1.86	9.30
0.24	1.90	9.50
0.25	1.94	9.69
0.26	1.98	9.89
0.27	2.01	10.07
0.28	2.05	10.26
0.30	2.12	10.62
0.31	2.16	10.80
0.32	2.19	10.97
0.33	2.23	11.14
0.34	2.26	11.31
0.35	2.29	11.47
0.36	2.33	11.63
0.38	2.39	11.95
0.40	2.45	12.26
0.42	2.51	12.57
0.44	2.57	12.86
0.46	2.63	13.15
0.48	2.69	13.43
0.50	2.74	13.71
0.52	2.80	13.98
0.56	2.90	14.51
0.60	3.00	15.02
0.70	3.24	16.22
0.80	3.47	17.34
0.90	3.68	18.39
1.00	3.88	19.39
1.10	4.07	20.33
1.20	4.25	21.24
1.30	4.42	22.11
1.40	4.59	22.94
1.50	4.75	23.75
1.70	5.06	25.28
1.90	5.35	26.73
2.10	5.62	28.10
2.50	6.13	30.66

HALF STREET FLOW CAPACITY CHART
6" VERTICAL CURB 20FT FC / CL

MANNING ROUGHNESS = 0.015
CURB HEIGHT = 0.592 FEET
CROSSSLOPE = 2% 20
CURB WIDTH = 0.5 FEET
STREET WIDTH TO B/C = 20 FEET
FLOW AREA, A = 7.0093 SQ FEET
WETTED PERIMETER, Pw = 20.50 FEET
HYDRAULIC RADIUS, R = 0.342 FEET

THIS SPREADSHEET IS ONLY ACCURATE IF THE CURB IS EQUAL TO OR LOWER THAN THE CENTER LINE OF THE ROADWAY

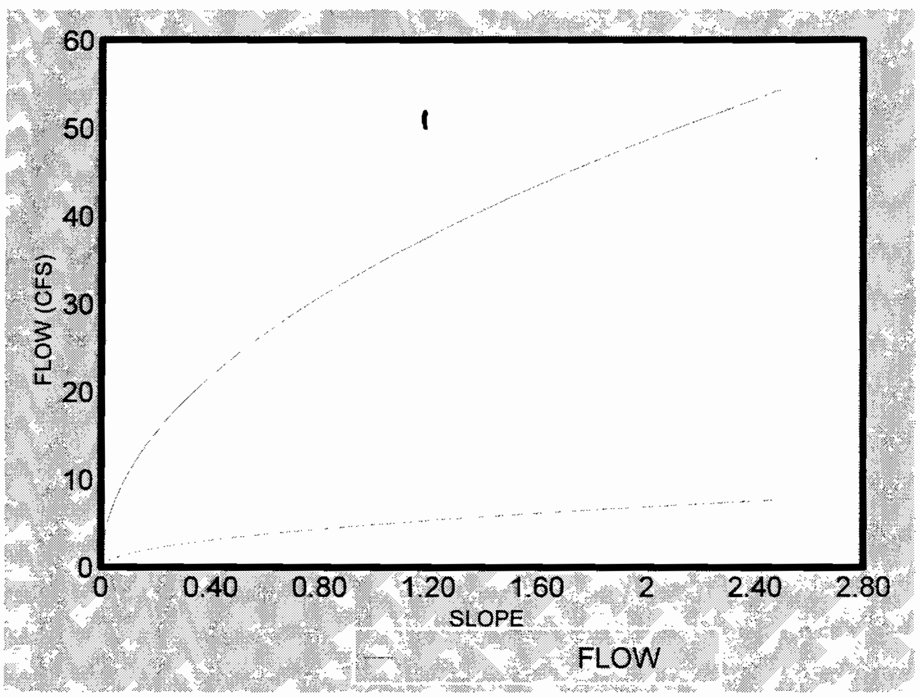


PERCENT SLOPE TABLE:	VELOCITY	FLOW
0.00	0.00	0.00
0.02	0.69	4.81
0.05	1.09	7.61
0.08	1.37	9.63
0.10	1.54	10.77
0.15	1.88	13.19
0.18	2.06	14.44
0.20	2.17	15.23
0.21	2.23	15.60
0.22	2.28	15.97
0.23	2.33	16.33
0.24	2.38	16.68
0.25	2.43	17.02
0.26	2.48	17.36
0.27	2.52	17.69
0.28	2.57	18.01
0.30	2.66	18.65
0.31	2.70	18.96
0.32	2.75	19.26
0.33	2.79	19.56
0.34	2.83	19.85
0.35	2.87	20.14
0.36	2.91	20.43
0.38	2.99	20.99
0.40	3.07	21.53
0.42	3.15	22.06
0.44	3.22	22.58
0.46	3.29	23.09
0.48	3.37	23.59
0.50	3.43	24.07
0.52	3.50	24.55
0.56	3.63	25.48
0.60	3.76	26.37
0.70	4.06	28.48
0.80	4.34	30.45
0.90	4.61	32.30
1.00	4.86	34.04
1.10	5.09	35.71
1.20	5.32	37.29
1.30	5.54	38.82
1.40	5.75	40.28
1.50	5.95	41.70
1.70	6.33	44.39
1.90	6.70	46.93
2.10	7.04	49.34
2.50	7.68	53.83

HALF STREET FLOW CAPACITY CHART
6" VERTICAL CURB 20FT FC / CL

MANNING ROUGHNESS = 0.015
CURB HEIGHT = 0.594 FEET
CROSSSLOPE = 2% 20
CURB WIDTH = 0.5 FEET
STREET WIDTH TO B/C = 20 FEET
FLOW AREA, A = 7.0567 SQ FEET
WETTED PERIMETER, Pw = 20.50 FEET
HYDRAULIC RADIUS, R = 0.344 FEET

THIS SPREADSHEET IS ONLY ACCURATE IF THE CURB IS EQUAL TO OR LOWER THAN THE CENTER LINE OF THE ROADWAY



PERCENT SLOPE TABLE:

	VELOCITY	FLOW
0.00	0.00	0.00
0.02	0.69	4.87
0.05	1.09	7.70
0.08	1.38	9.74
0.10	1.54	10.89
0.15	1.89	13.33
0.18	2.07	14.61
0.20	2.18	15.40
0.21	2.24	15.78
0.22	2.29	16.15
0.23	2.34	16.51
0.24	2.39	16.87
0.25	2.44	17.21
0.26	2.49	17.56
0.27	2.54	17.89
0.28	2.58	18.22
0.30	2.67	18.86
0.31	2.72	19.17
0.32	2.76	19.48
0.33	2.80	19.78
0.34	2.84	20.08
0.35	2.89	20.37
0.36	2.93	20.66
0.38	3.01	21.22
0.40	3.09	21.78
0.42	3.16	22.31
0.44	3.24	22.84
0.46	3.31	23.35
0.48	3.38	23.85
0.50	3.45	24.35
0.52	3.52	24.83
0.56	3.65	25.76
0.60	3.78	26.67
0.70	4.08	28.81
0.80	4.36	30.79
0.90	4.63	32.66
1.00	4.88	34.43
1.10	5.12	36.11
1.20	5.34	37.72
1.30	5.56	39.26
1.40	5.77	40.74
1.50	5.98	42.17
1.70	6.36	44.89
1.90	6.73	47.46
2.10	7.07	49.89
2.50	7.71	54.44

Figure 2-5

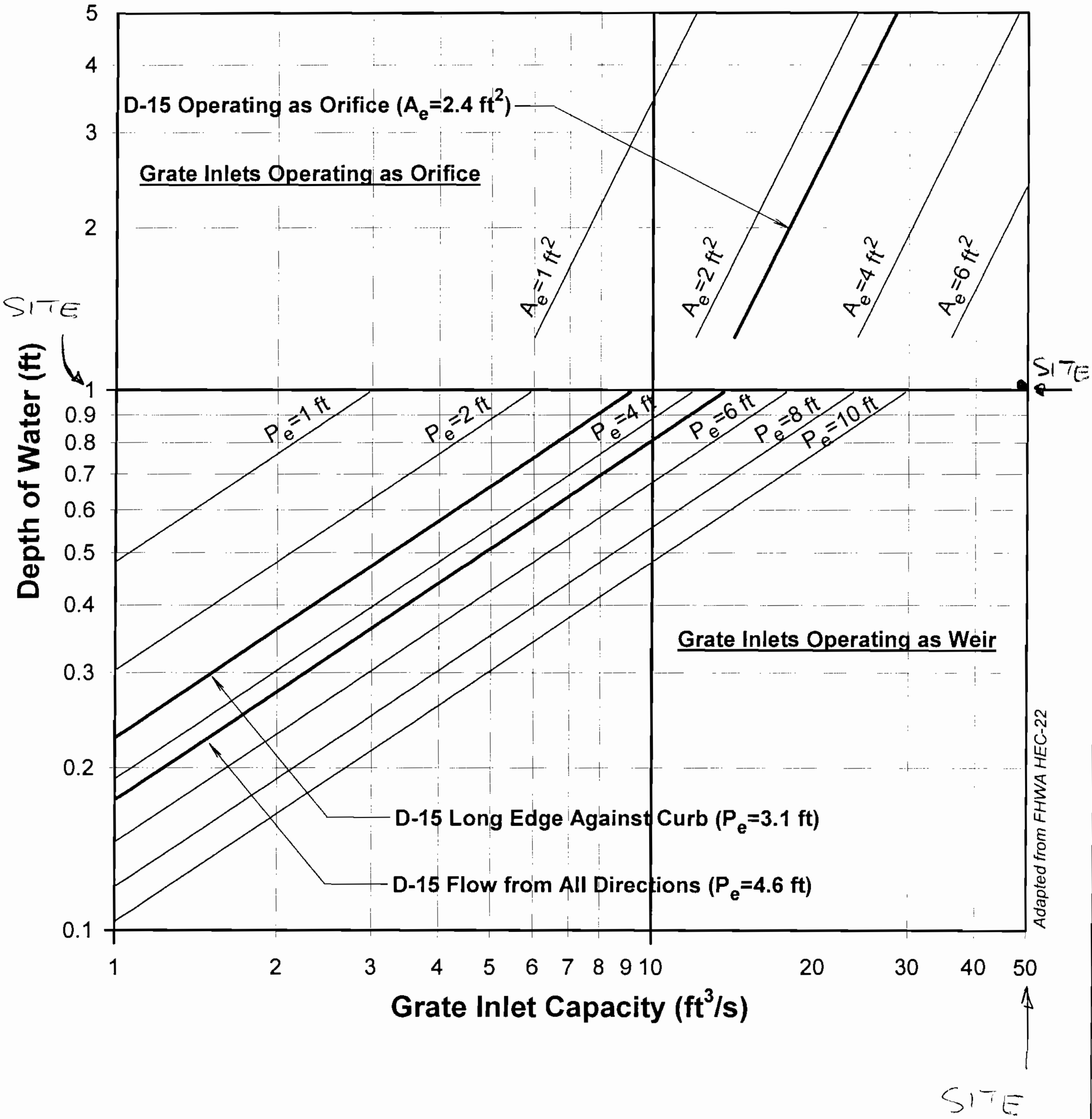


Figure 2-5 Capacity of Grate Inlets in Sump Locations